University of Idaho Reclaimed Water System

Introduction

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Reclaimed Water System

Presenters:

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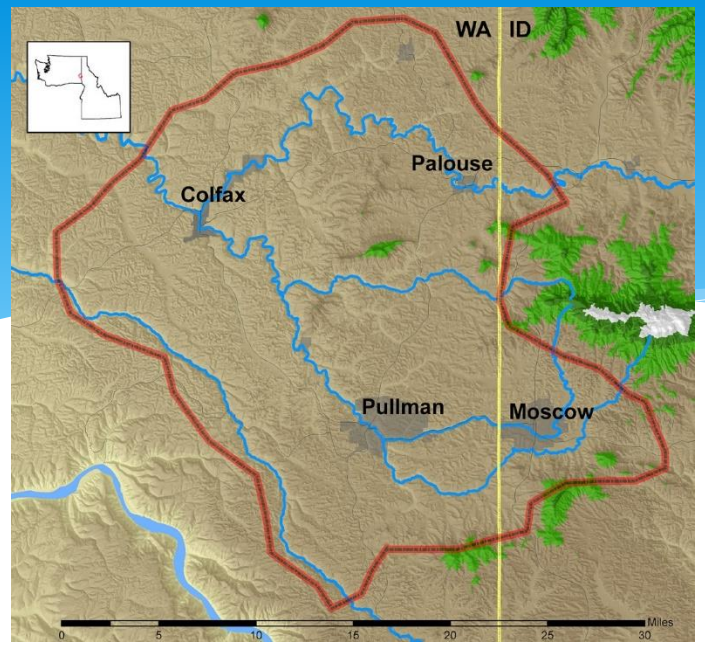

Justification

* The University of Idaho is located in the Palouse basin of north Idaho. And, like the surrounding entities, receives all water from aquifers of the Grande Ronde and Wanapum strata. The Grande Ronde aquifer is presently, in a steady state of decline at .6 feet per year with mean rates of decline recorded at one to two feet per year since 1967. The declining aquifer coupled with drought experienced in the early seventies found the University of Idaho seeking an alternative water source for irrigation of the golf course, and recreational fields to alleviate pressure on local aquifers.

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Partnership

* In 1970 the University of Idaho and City of Moscow engaged in discussions of reuse of City's waste water effluent.
* In June 21 1977 University of Idaho and the City of Moscow agreed that the University of Idaho would obtain a water right for the discharge from the City's Waste Water Treatment Plant.
* Each entity entered into a cooperative agreement to reduce the growing demand of water pumped from the precious yet declining aquifers.
* The effluent from the City's waste water plant is a great consistent source of high quality water which, in early application, was nutrient rich.

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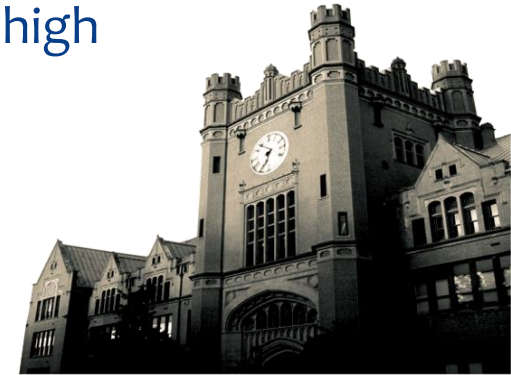

The System

* **Classification (IDAPA 58.01.17):** The U of I reclaimed water system is a class B system.
* **Beneficial Use:** Est. in 1977 we currently land apply reuse water to 183 acres for beneficial use.
* **Average Supply:** Over the last ten years the average annual use was 85.2 million gallons between May thru October 2016.
* **Capacity:** The system has a 500,000 gal reservoir at the plant with 2 x storage Lagoons at the Golf Course; Pond 1) 1.1 MG and Pond 2) 600K G. Capable of irrigating 183 Acres at 1200 gpm of 1.2 MGD or 1-day supply of water. During Peak evapotranspiration (ET) periods must use domestic make up water; WWTP decreases effluent during July and August. Transient student population causes a decrease in flow to just over 1.0 MGD processing at WWTP. 500 K storage captures diurnal flow of the WWTP.
* **Main Distribution:** Reclaimed distribution is supported by approximately 5 miles of main line, 4" pipe or larger.
* **Zone Distribution:** Distribution is zoned with approximately 60 miles of irrigation water lines.

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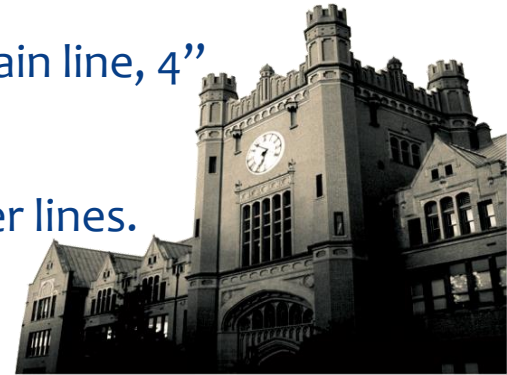
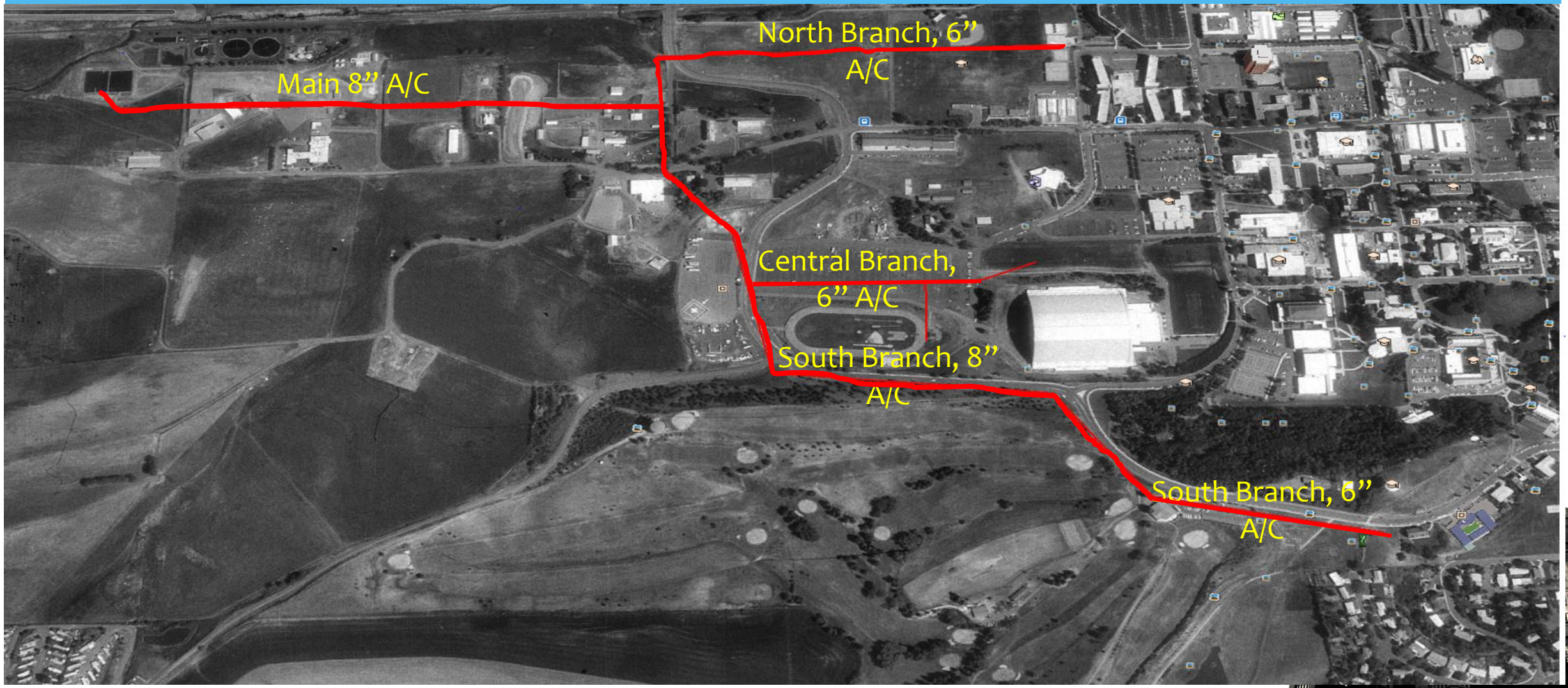


Construction

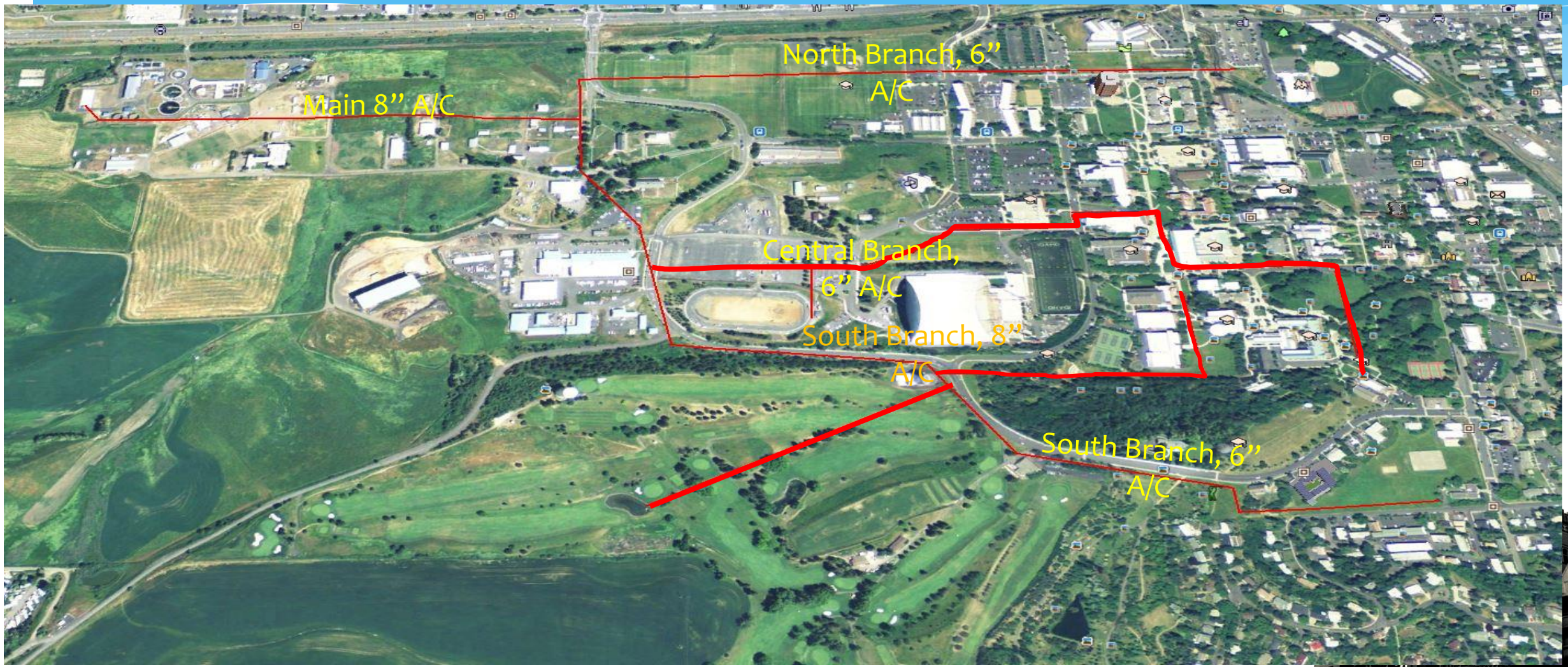
* In 1977 the University of Idaho took out a 40 year bond to construct a reclaimed water system just west of the city's present day waste water treatment plant (WWTP) serving the University's west campus . Note: the Final payment is scheduled for 8/1/2017.

* Initially, two holding ponds were constructed to receive discharge from the WWTP that subsequently was pumped thru one - 150 horse power centrifugal pump to supply an 8" (inch) irrigation main branching out to three 6 inch irrigation pipes.

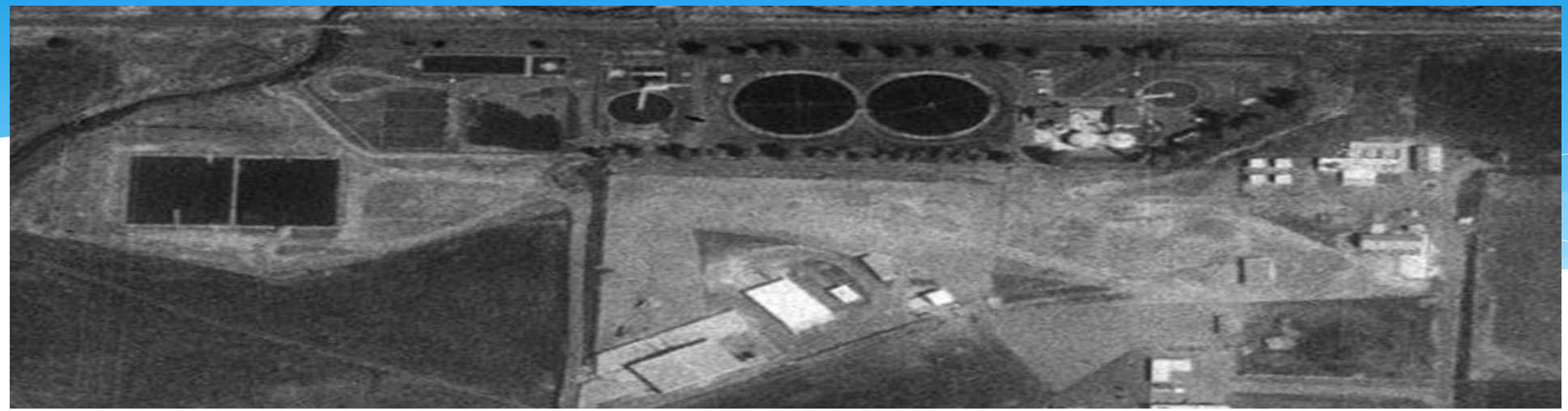
Construction



Present day Irrigation mains



The Earlier Years



* **Water Quality:** The quality of water received from the City's waste water treatment plant was consistent with a trickling filter plant.

* **Pump:** A single - 150 horse power centrifugal pump supplies water.

* **First Use:** From 1978 thru 1987, annual pumping rate was around 40 million gallons a year.

* **Permitting:** 1988 was the first year of operating the system under a DEQ reuse land application permit

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Growing Dates

* **2002:** the City of Moscow Waste Water Treatment Plant switched from trickling filters to the new biologic phosphorus removal treatment process.

* **2006:** UI constructs a new chemical building and changed the disinfection process from using gas chlorine to sodium hypochlorite system.

* **2008:** To meet phosphorus discharge limits, the City of Moscow Waste Water Treatment Plant installed a tertiary filtration system.

* **2010:** The University of Idaho changed to underground 500,000 gallon reservoir with a 5 channel serpentine built-in for additional contact time for disinfection.

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Old lagoon

Present Day Chemical Building

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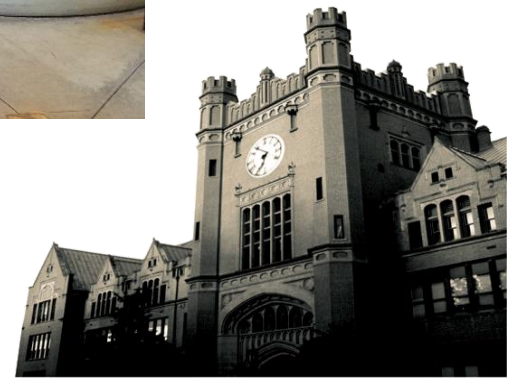

Construction of Resevoir

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Present Day Storage Tank

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Present

* University and City of Moscow Collaboration:

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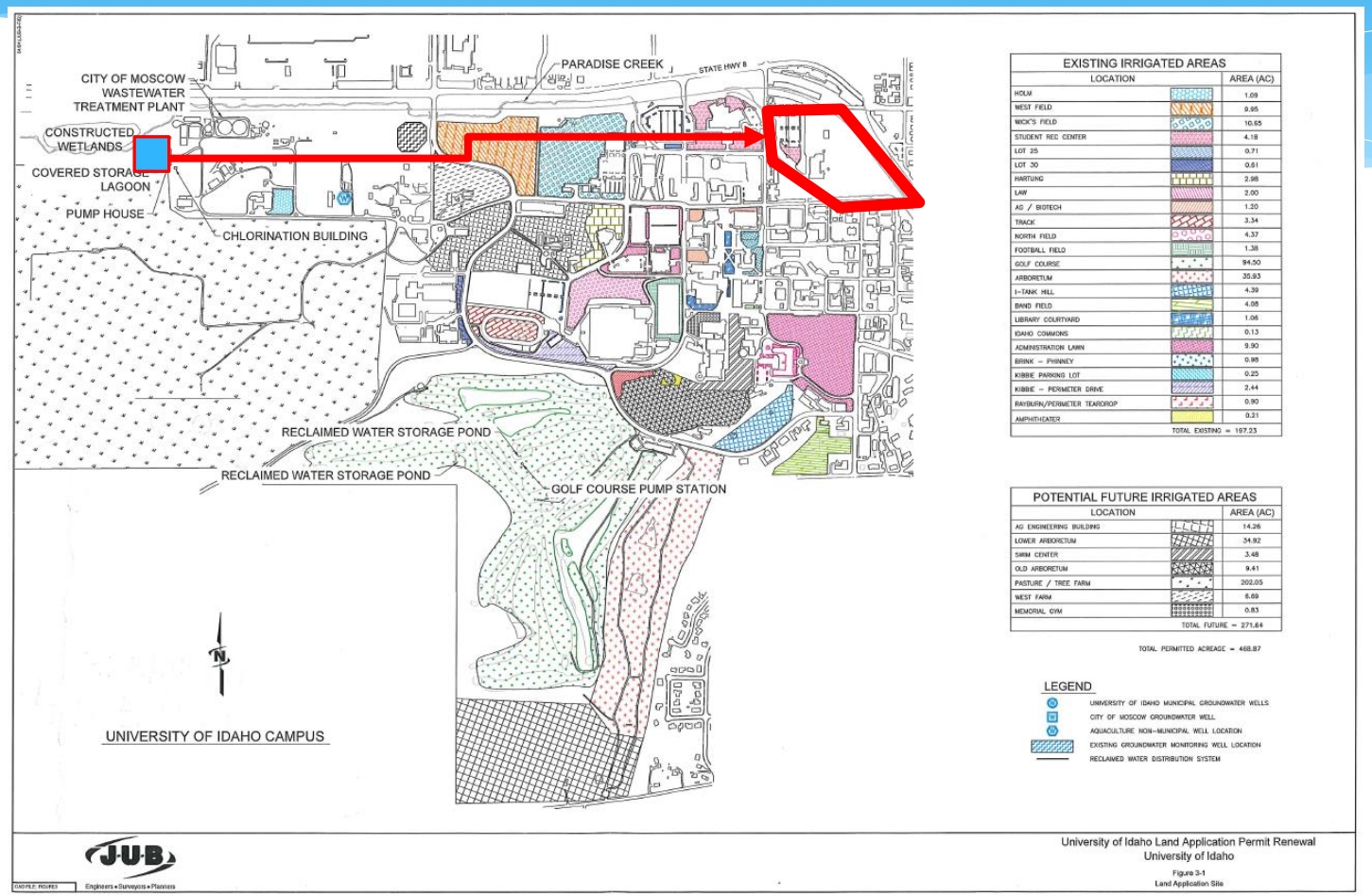
Possible Expansion

- **Ghormley Park City of Moscow:** New "purple pipe" .
- **PBAC:** Water supply alternatives.
- **Permitting:** UI will begin engaging in master planning supporting expansion in 2018 – 2020.



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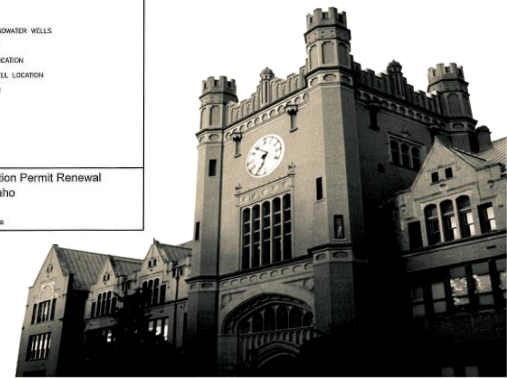

Lessons Learned

* **Tank Storage:** Closed tank over open lagoon made it easier to maintain disinfection level by protecting from and open air environment (UV light, Algae Growth, Dirt in air, Bird dropping, Decaying rodents), easier to clean, security.
* **Intertie and Systems Controls:** Intertying control systems increased reliability and compliance.
* **Water circulation:** Recycling water in tank during no usage increases quality. Accomplished to meet chlorine residual, and bacterial control.
* **Safety and disinfection:** Nothing beats chlorine gas but, safety comes first. Use of Sodium Hypochlorite reduces risk of accidents and criminal acts including terrorism.
* **Redundancy:** Building in redundancy into the system (pumps, screens, valves).

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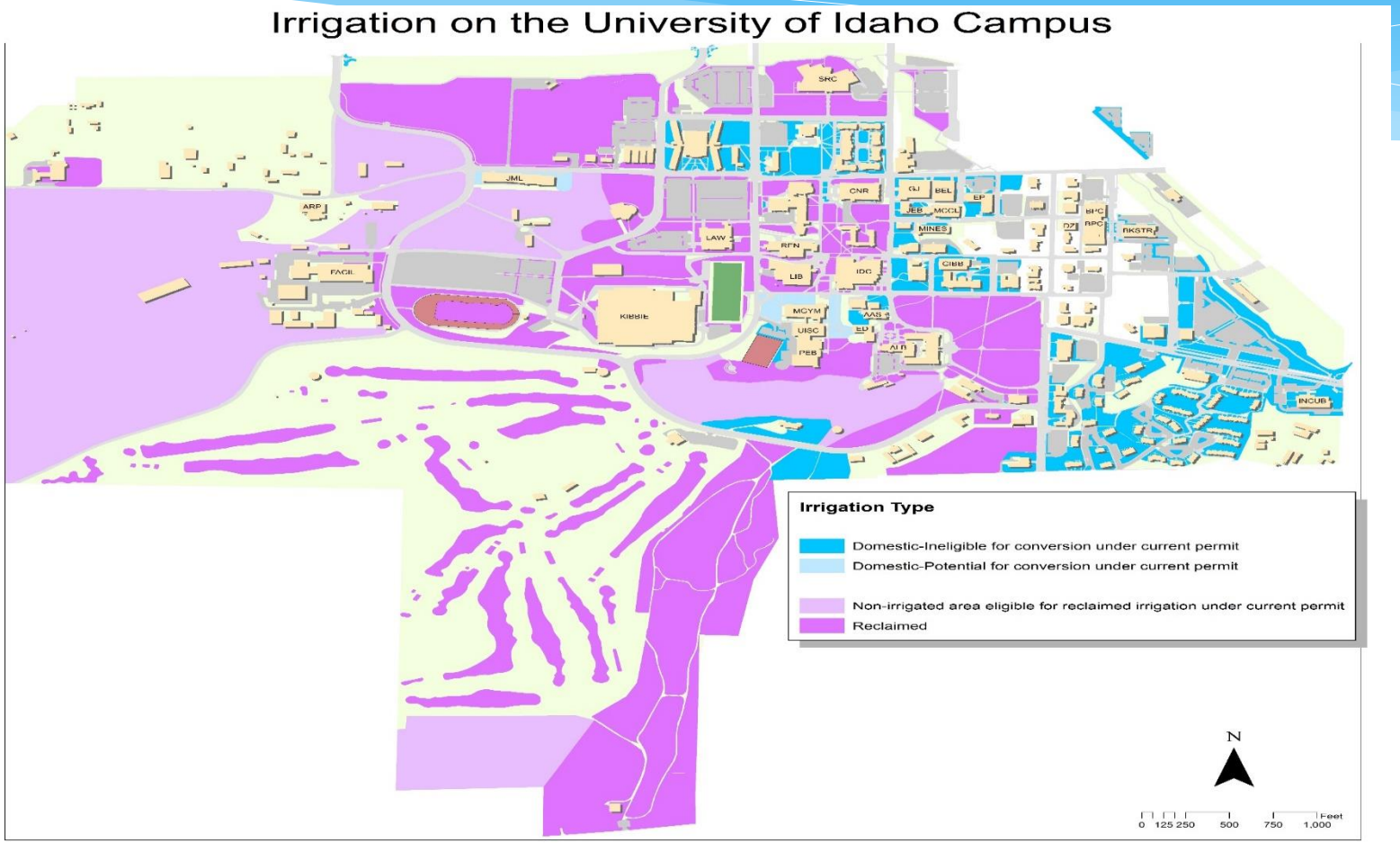
Present day Irrigation Map
(Domestic vs Reclaimed)



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Making the Difference

* **Production and Total Pumping:** U of I pumped over 2.5 billion gallons of reclaimed water since 1977.
* **Combined Production:** The total combine domestic water usage from all the entities that pump from the local aquifer was 2.4 billion last year 2016; Note: this includes University of Idaho, Washington State University, City of Pullman, City of Moscow, Latah and Whitman Counties.
* **Reclaimed Impacts:** As illustrated in Slide (21), the University supplied 40% of its own water through reclaimed water usage during 2016.
* **Aquifer Impairment:** Thru corporative efforts the rate of pumping declined on the local aquifers decreasing to 0.6 feet per year.
* **Uncertainty:** Theoretically, assuming specific aquifer parameters the aquifer has approximately 400-years of viability at this rate of decline but, no one knows for certain? So, where is the end?
* **Alternatives:** Sustainability Insures preservation and protection of resources for future generations, reclamation provides an alternative.

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Palouse Basin Aquifer Committee

* **Palouse Basin Aquifer Committee (PBAC):** The University of Idaho is a signatory of the Palouse Ground Water Management Plan and a member of the interstate organization known as the Palouse Basin Aquifer Committee (PBAC) dedicated to the conservation and management for the preservation and protection of water resources within the Palouse Basin. UI through this organization works at the local, municipal, regional, state, and national level to serve interests in policy and legislation for the development of alternative water resources and supply and to instill cultural change in the conservation and preservation of water resources for future generations.

* **Entities Engaged in PBAC:**
  - University of Idaho
  - Washington Sate University
  - City of Pullman, Washington
  - City of Moscow, Idaho
  - Latah County, Idaho
  - Whitman County, Washington

- **Idaho Code 42:** Mining the aquifer is withdrawing water at rate greater than recharge (impairment).

- **Alternative Water Supplies:** Reclamation, recycling and reuse of water.

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Water Usage and University Population

* University of Idaho: 5,200 bed spaces serving residential living

* Per Capita Use:
  - Residents: 105 GPD
  - Nonresidents: 5 GPD
  - Mean demand per Capita: 73 GPD

* Growth:
  - Past Population 1955: 6,164
  - Present Population 2016: 11,780
  - Future Growth 2025: 17,500

* Domestic Water Demand: 139 MGY

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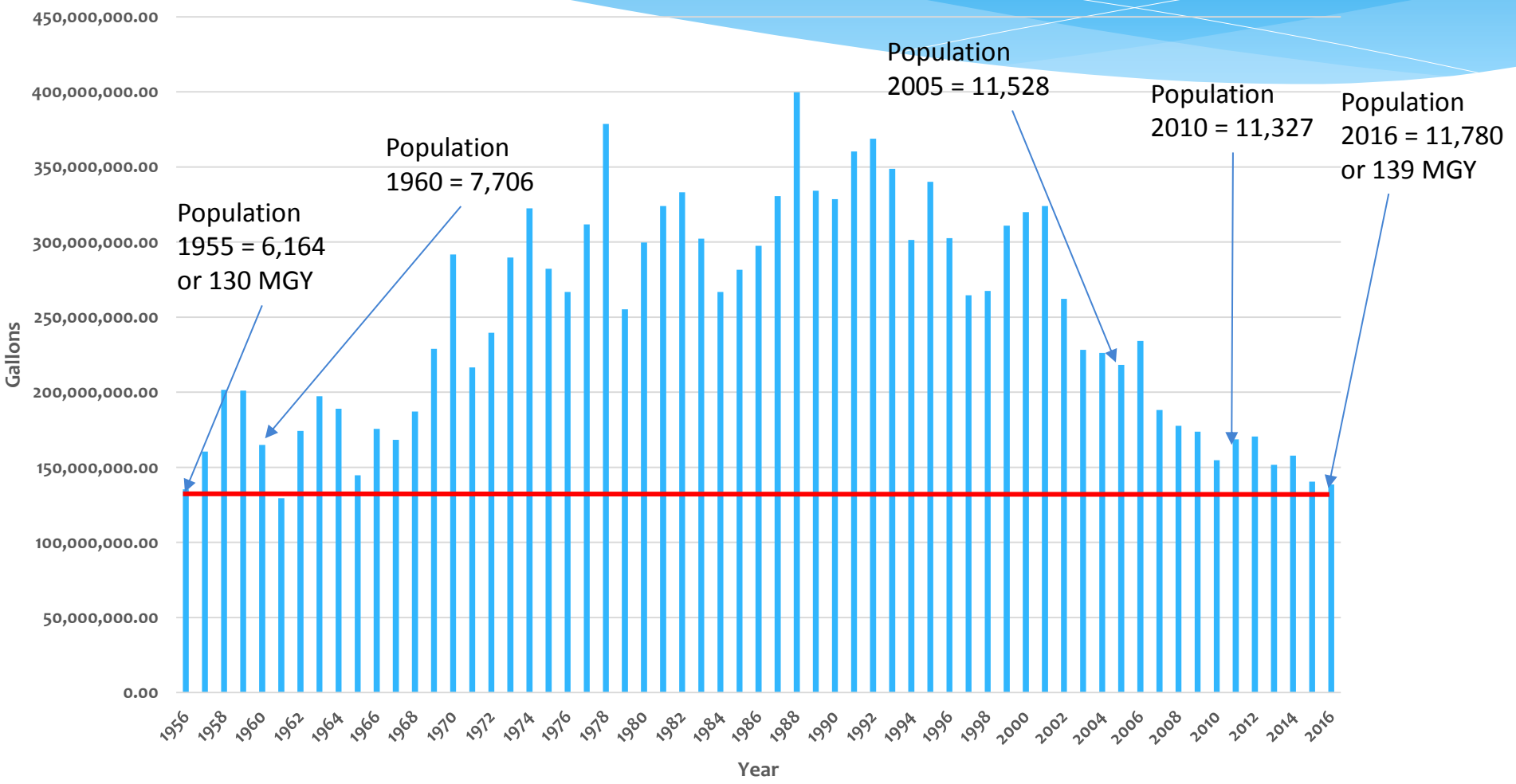
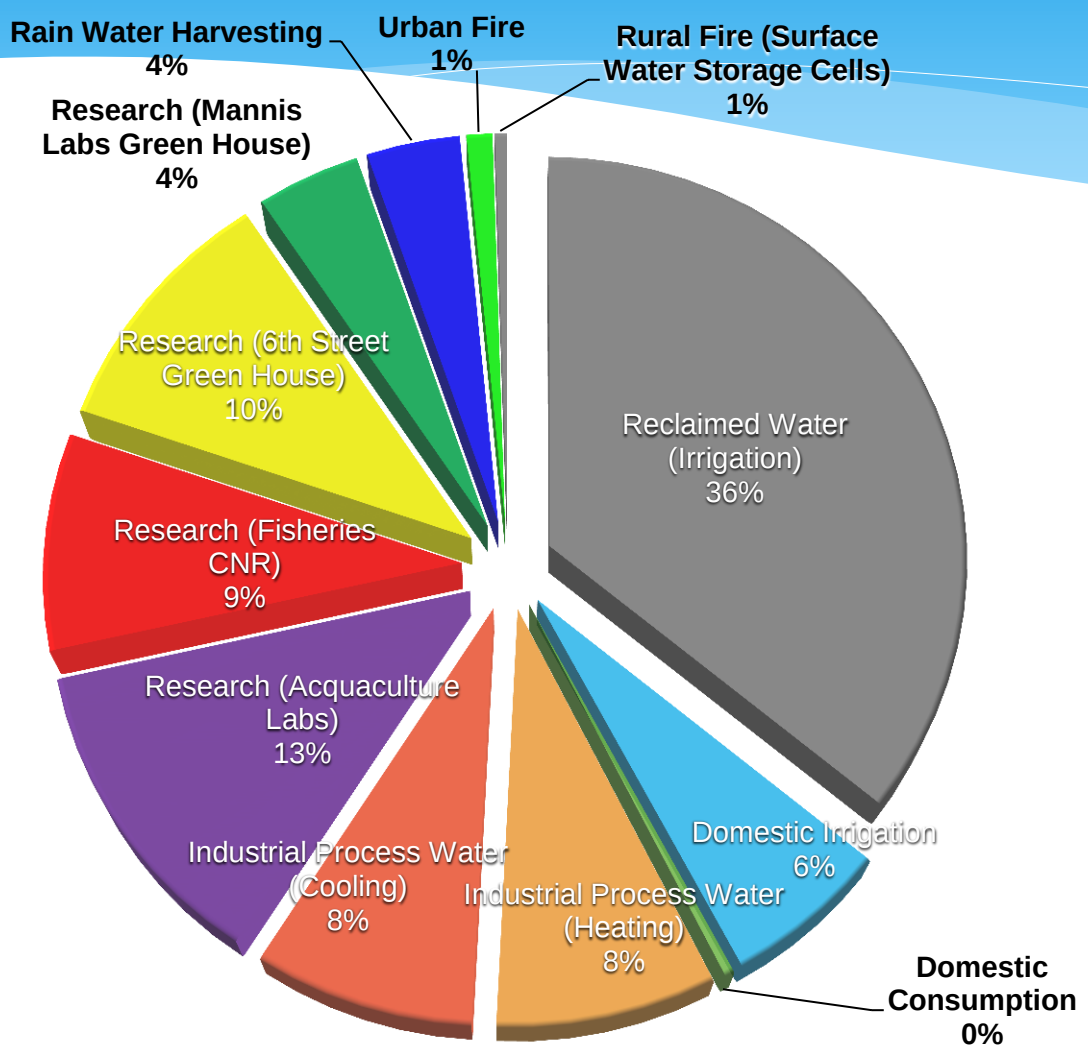
Domestic Water Consumption



* As our population has grown domestic water use on campus has reduced
* By implementing Best Practices the University of Idaho is a good steward of water as a resource.

Note 1: Reference for University Population: Gibbs, Rafe, "Beacon for Mountain and Plain; Storey of the University of Idaho", Regents of Idaho, 1962.

University of Idaho Water Profile



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- Reclaimed Water (Irrigation)
- Domestic Irrigation
- Domestic Consumption
- Industrial Process Water (Heating)
- Industrial Process Water (Cooling)
- Research (Acquaculture Labs)
- Research (Fisheries CNR)
- Research (6th Street Green House)
- Research (Mannis Labs Green House)
- Recreation (Swimming Pools)
- Rain Water Harvesting
- Urban Fire
- Rural Fire (Surface Water Storage Cells)

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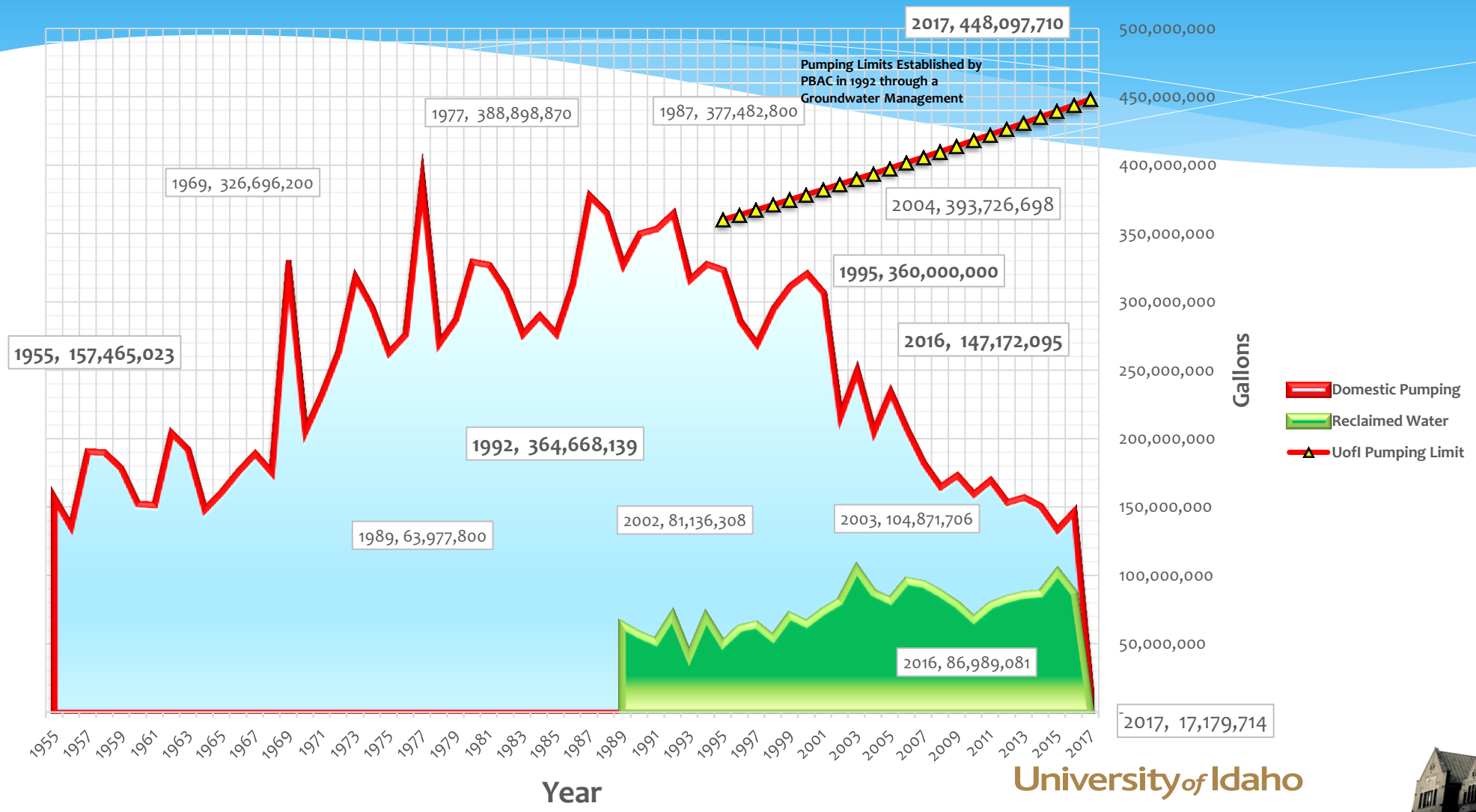
Pumping History Recorded 1955 - Present



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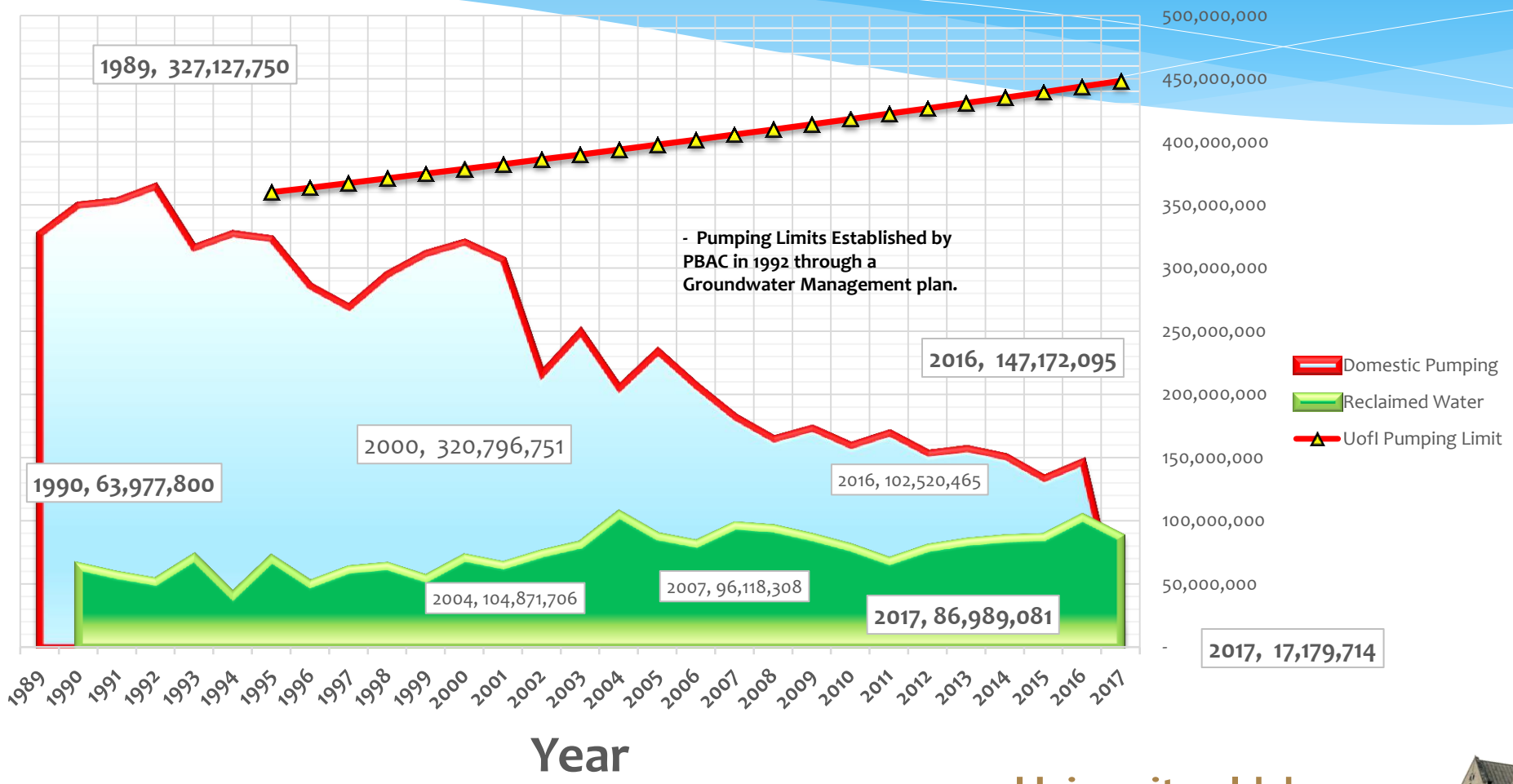
Relative Pumping Rates
1990 to Present



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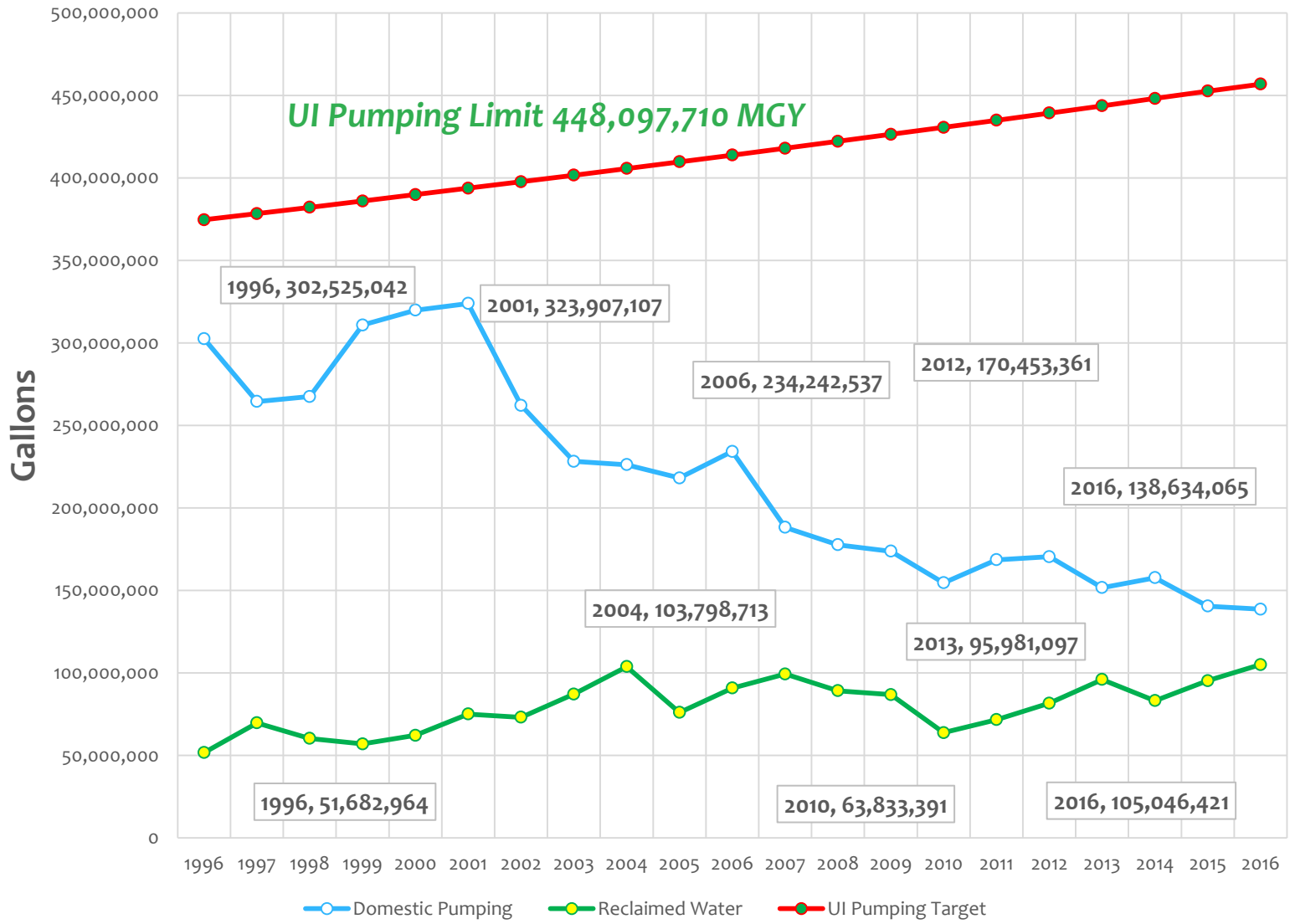
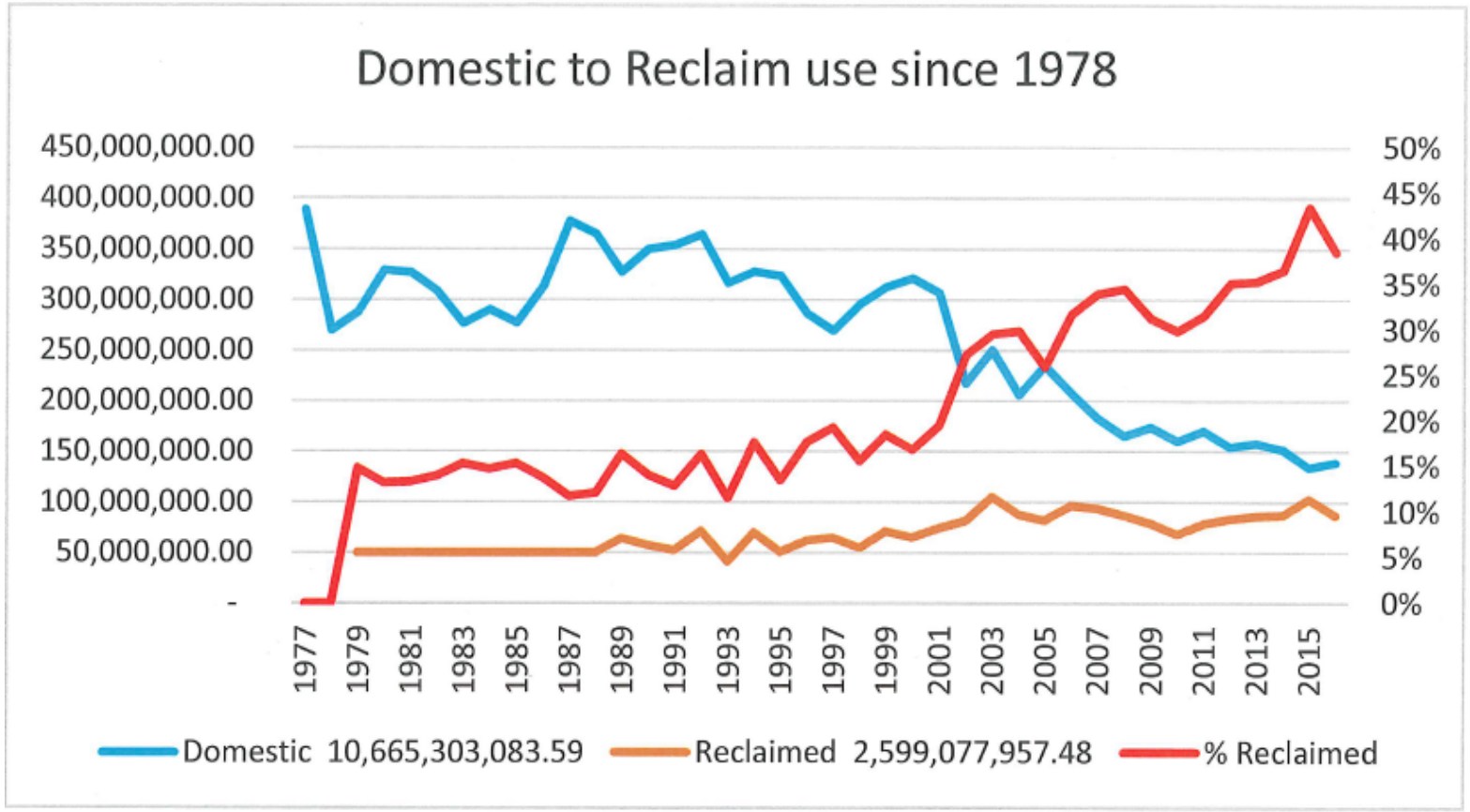
Water Usage



Domestic vs Reclaimed Water

- Data As of September 29 2016.
- Domestic Water 139 million gallons FY16
- Reclaimed water for Irrigation 105 million gallons FY16
- Domestic Water is Subject to Research Demands.
- Improved Leak Detection.
- Preventive Maintenance.
- 36% of the Total usage is reclaimed water.
- Land-grant Research institution
- NOTE: Not reflected in this graph are the values related to research aquaculture etc.

Making a Difference



Note: UI uses almost all the water available by the City of Moscow WWTP during peak irrigation periods.

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Capital Investment

Reclaimed water system Capital costs: $ 1,943,482

- Initial Capital Investment 1977: $ 386,482 (50% Grant/ 50% 40-year Bond)
- Extension to Band Field 1986: $ 48,000 Internal funding
- Storage Reservoir Upgrade: $ 50,000 Internal funding
  - ✓ new pump and wet well
- North Field to Renfrew: $ 105,000
  - ✓ University Street Pipe Extension
- University Street Extension Admin. Lawn: $ 54,000
- New Disinfection Chemical Lagoon Building: $ 400,000
- New Storage Facility and Pump House: $ 900,000

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Steady State Operations and Maintenance

Annual Operational and Maintenance Costs:

Steady State O&M Costs			
Other Costs	**Total Invested**	**Freq (yrs).**	**Cost/Year**
1.2 FTE	$ 18,000.00	1	$ 18,000.00
DEQ Report/yearly	$ 4,000.00	1	$4,000.00
Main Irrigation Pump	$ 10,000.00	10	$1,000.00
A/C Motors	$ 11,000.00	10	$1,100.00
Holding Tank	$ 800,000.00	30	$26,666.67
New Cells for Chlorinator	$ 26,000.00	5	$5,200.00
Chlorination	$ 400,000.00	30	$13,333.33
Electric Consumption (kWh)	$ 304,093.00	0.055	$16,725.12
City of Moscow WWTP Water Processing	$ 1,015,000.00	1	$ 1,155,000.00
Total Yearly Cost			$ 1,241,025.12
Total Irrigation Annually MGY			86,000,000
Cost per gallon			$ 0.01443
Cost per CCF			$ 0.001929215
Golf Course Irrigation Acres			98
Recreation Fields			30
Arboretum			39
Campus Interior Lawns			53.5
Total Irrigation Annually Acrage			220.5

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The advantages of using Reclaimed

* **Demand Reduction:** Reduces the demand on the local aquifer.
* **Nutrient Benefit:** Reduction in fertilizer in irrigated areas from some of the nutrients normally found in waste water treatment plant effluent.
* **Point Source Discharge:** Reduces points of discharge to Paradise Creek serving TMDL in bacteria as well as temperature.
* **Temperature TMDL:** Reduced effluent temperature by reducing discharge to Paradise Creek serves Paradise Creek as an MS4, beneficial use to salmonids.
* **Sustainability:** Promoting good stewardship of university resources; Sustainability (good public relations)

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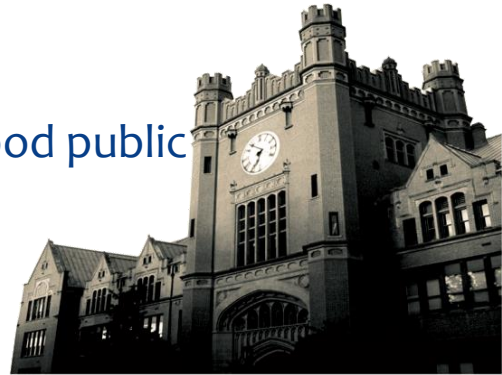

Disadvantages of using Reclaimed

* **Regulation:** Tighter regulation of reclaimed over potable water use; See IDAPA 58.01.17.
* **Application:** Dependent upon class of system times of irrigating and buffer zones.
* **Additional costs:** Having another infrastructure system of plant, pumps, pipe, chemicals, testing and other item related to requirements.
* **Licensing:** Additional licensing and training of personal required to support reclaimed systems including but not limited to reclaimed use permits and storage reservoir and lagoon permits.
* **Nutrient Value:** As tighter regulations over the years were placed on the city's waste water plant discharge reduced the nutrients benefits.

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Concerns of using Reclaimed Water

* **Public Health**: Possibility of causing people to become ill from drinking the irrigation water (people do not always read the signs, especially small children).
  Action: Actively irrigating during periods of non use or withoversite; i.e. at Night or under direct supervision.

* **Pathogens**: Aerosols can carry pathogenic organism over to property which receives public use.
  Action: Maintain proper disinfection level, contact time and testing.

* **Nitrates, and Sulfates**: Salts build-up in the soils overtime contributing to surface water runoff.
  Action: Effluent testing, soil sampling and continuing to monitor soils; Salts are found predonminately in industrial.

* **Surface Water Pollution**: Potentially contribute to surface water pollution.
  Action: Controlling runoff, not overwatering, practicing best turf management.

- **Public Perception**: Public adversity as a result of the "ICK FACTOR" Endocrine Disruptors impacts total application.
  Action: Public Outreach and notification of use both economic and resource preservation.

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What's in the future for our system?

* **Installing a Central irrigation control system:** Stewards available resources
* **Possibility of going to class A system:** Increases ground available for irrigation and further reduces health risks.
* **Looping dead end mains:** Affords continuous maintenance and constant pressurization.
* **Building in more storage lagoons:** Increased capacity support expansion of the system to broaden services.
* **Installing bigger irrigation mains:** Broaden services.
* **Extending our irrigation system:** Increases support to accommodate both the City of Moscow and University of Idaho.

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The Future

* As our population grows so does the demand on the local fresh water sources. Increased demands for potable water translates to an important water management concern. Concerns include preserving and protecting ground and surface water sources while, providing fresh water required for serving everyday uses, such as drinking, sanitary services, life support and landscape irrigation. The use of reclaimed water aid in preservation of ground water sources for drinking water by providing a reliable and economical alterative source of irrigation water.

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The benefits of reuse water